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THE HEATING VALUES AND PROXIMATE ANALYSES OF MISSOURI COAL.

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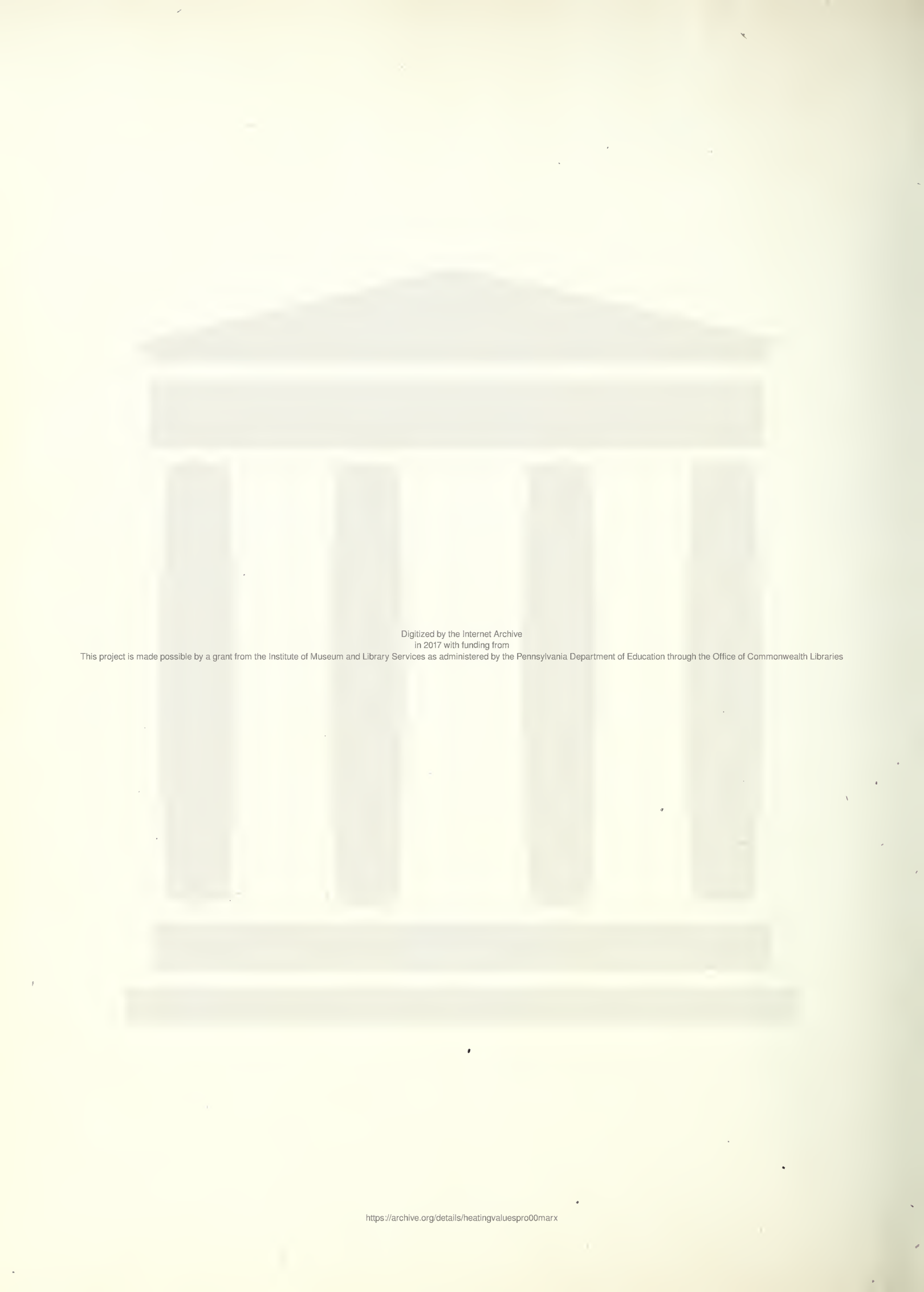

Heating Values and Proximate Analyses of Missouri Coals.

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During the fall and winter of 1900-1901 the writer undertook a systematic investigation of the coals mined in Missouri. All the samples, save one, were cut from the face down through the entire thickness of the vein. A sample of about forty pounds thus collected from each mine was carefully sampled down to fill a Mason quart jar which, properly sealed, was taken without delay to the Experiment Station Laboratory where all analytical work including heat values by the bomb calorimeter was done. The calorimeter results have been calculated on the basis of the coal as taken from the mine to be burned.

The value of a fuel depends upon the number of heat units that it will produce and is usually measured in number of pounds of water that one pound of such fuel will evaporate or convert into steam. This is called its calorific value and is really the value for steam boiler purposes obtained per pound of coal.

Although coal is the most important mineral of Missouri, no thorough and complete investigation of the calorific values of her coals has hitherto been made, so far as is known. The two Departments of the State University above mentioned have undertaken, therefore, such an investigation and now print a report of the same. Professor Marx visited every mine mentioned, took the samples in person at the face, except in the case of sample No. 7. On account of the lateness of the hour and the condition of the entrance to the mine this sample was picked from a car that seemed to have been loaded during the day.

EXPLANATION OF TERMS.

A heat unit is the quantity of heat required to raise the temperature of one pound of water, at its maximum density, one degree Fahrenheit. The expression from and at 212 degrees F. means that the water is taken in at a temperature of 212 degrees Fahrenheit and evaporated at atmospheric pressure. Thus all the heat is used to evaporate the water. This is merely an arbitrary standard used in boiler-testing.

In table I, the column headed heat units per pound of coal is the maximum number of heat units that one pound of coal will yield when burned in a furnace where there are no losses of any kind. The number of pounds of water that a pound of coal will evaporate from and at 212 degrees F. depends upon the efficiency of the boiler and furnace. The efficiency of boilers in our western states with the ordinary furnace and setting generally varies from 50 per cent to 60 per cent, but in a great many cases it is far below 50 per cent. With mechanical stokers, uniform duty, well designed boiler, and well designed furnace, an efficiency of 70 per cent is easily maintained. Assuming a boiler efficiency of 60 per cent the last column in table I was computed. It shows the number of pounds of water that one pound of the various coals would evaporate under favorable conditions with such an efficiency (60 per cent), the water being taken in at 212 degrees F. and evaporated at atmospheric pressure.

Table I shows the rank of the coals arranged according to their calorific value.

I.—TABLE SHOWING CALORIFIC VALUE OF MISSOURI COALS.

Rank.	Name of Mine.	County.	Location.	Thickness of vein in inches.	Heat units per pound of coal.	Pounds of water evaporated from and at 212° F. per lb. of coal. Boiler efficiency 60%.
1	No. 8, Western Coal Co	Barton	Near Minden Station	36	13763	8.55
2	No. 3, Weir Coal Co	Barton	Near Vernon Station	36	13759	8.55
3	Brush Creek Coal Co. Upper Vein	Jackson	3 miles S. E. of Kansas City	16	13710	8.52
4	No. 14, Central Coal and Coke Co	Bates	5 miles South of Rich Hill	60-66	13500	8.38
5	Rush Coal Co	Bates	5 miles South of Rich Hill 1 1-2 miles West of previous one	42	12824	7.96
6	Keene	Boone	4 1-2 miles North of Columbia	44	12780	7.94
7	Thompson	Henry	1 mile East of Deepwater		12757	7.92
8	Henry	Boone	Switzler	42	12492	7.76
9	Cooper Creek Coal Co	Henry	3 1-2 miles S. E. of Deepwater	32-42	12326	7.66
10	Kingston	Caldwell	1 mile North of Kingston	12-18	12292	7.63
11	Caldwell Coal Co	Caldwell	2 miles East of Hamilton	18-20	12115	7.52
12	Bowen Bros.	Henry	1-2 mile N. E. Louis Station	30	12093	7.51
13	Watkins	Henry	1 1-2 mile S. E. of Clinton	24	12090	7.51
14	Excelsior	Lafayette	1-2 mile West of Higginsville	16	12010	7.46
15	Vernon Coal Co	Bates	2 1-2 miles S. E. of Rich Hill	36-60	11978	7.44
16	Marceline Coal Co	Linn	1-2 mile South of Marceline	28	11939	7.41
17	Murlin Coal Co	Adair	1-2 mile North of Stahl	48	11854	7.36
18	No. 15, Rich Hill Coal Co	Bates	2 miles South of Rich Hill	48	11834	7.35
19	Edmonds	Lafayette	1-4 mile East of Waterloo	18	11829	7.35
20	No. 6, Farmers Consolidated	Lafayette	1 mile West of Higginsville	16	11824	7.34
21	No. 66, Kansas & Texas Coal Co	Macon	3 miles South of Bevier	56	11769	7.31
22	Silver Creek Coal Co	Lafayette	1-4 mile West of Waverly Station	48	11764	7.30
23	Elliott Coal Co	Randolph	Elliott Station	48	11676	7.24
24	Buckhorn Coal Co	Lafayette	1 mile West of Waverly Station	48	11643	7.23
25	No. 10, Morris Coal Co	Randolph	1 mile East of Huntsville	48	11642	7.23
26	No. 70, Kansas & Texas Coal Co	Macon	4 1-2 miles S. W. of Excello	54	11626	7.22
27	Murlin Coal Co	Ray	Fleming Station	22	11583	7.19
28	Salt Fork Coal Co	Lafayette	1-2 mile East of Corder	22	11580	7.19
29	Jones & Davis	Randolph	3 miles West of Moberly	48	11574	7.19
30	Brush Creek Coal Co. Lower Vein	Jackson	3 miles S. E. of Kansas City	24	11524	7.16
31	No. 1, Higbee	Lafayette	1-2 mile West of Higbee	44-48	11522	7.15
32	Labor Exchange	Lafayette	1 1-4 miles West of Wellington	18	11492	7.14
33	No. 1, J. C. McGrew	Lafayette	3 1-2 miles West of Lexington	22	11395	7.08
34	Emporia	Putnam	1 1-4 mile North of Unionville	36	11390	7.07
35	No. 61, Kansas & Texas Coal Co	Macon	2 miles S. W. of Bevier	51	11372	7.06
36	Richmond & Camden Coal Co	Ray	1 mile West of Camden	20	11331	7.04
37	No. 11, Richmond & Camden Coal Co	Ray	1 mile West of Richmond	24	11322	7.03
38	No. 8, Mendota Coal Co Mo. City Coal Co	Putnam Clay	1-2 mile South of Mendota Station Missouri City	36 22	11274 11274	7.00 7.00
39	No. 14, Richmond & Camden Coal Co	Ray	1-4 mile South of Richmond	24	11250	6.99
40	Corder Coal Co	Lafayette	3-4 mile West of Corder	22	11233	6.98
41	Glen Oak, Lexington Coal Co	Lafayette	4 miles N. E. of Lexington	24	11220	6.97
42	Valley Mine, Lexington Coal Co	Lafayette	1 1-2 mile South of Lexington	22	11209	6.96
43	North Western Coal Co	Macon	1 mile South of Bevier	42-48	11191	6 95
44	No. 2, Higbee	Lafayette	2 miles East of Higbee	42	11147	6.92
45	Dover Coal Co	Lafayette	1 mile East of Dover Station	18	11018	6.84
46	Rombauer	Adair	1-2 mile West of Novinger	43	10877	6.77
47	Carter	Lafayette	1 1-2 mile East of Wellington	20	10770	6.69
48	Graddy-Lexington Coal Co	Lafayette	3 miles West of Lexington	20	10759	6.68
49	Grundy Coal Co	Grundy	1-2 mile S. E. Trenton	18	10704	6.65
50	J. B. Seitz	Lafayette	3-4 mile West of Waterloo	18	10664	6.62
51	No. 2, Mendota Coal Co	Putnam	2 miles S. E. Mentota Station	34	10623	6.60
52	Mayview Coal Co	Lafayette	Near Mayview station	18	10458	6.50
53	Blackbird	Putnam	3 miles N. E. of Unionville	34	10437	6.48
54	Lingo	Macon	Opposite Lingo Station	36-42	10224	6.35

Table II shows the same coals according to their rank as in table I with their proximate analyses. These proximate analyses were made according to accepted methods. All coals were analyzed and tested in duplicate. Since some of the coals showed the presence of gypsum, it was

deemed best not to subtract the sulphur found from the volatile matter and from the fixed carbon as is usually done.

The last column in table II shows how far the calorific value of a coal is dependent upon the amount of the volatile matter and fixed carbon. A study of this column will show that with few exceptions the sum of these two percentages seems to determine the rank of the coal, the same as the calorific value did in table I.

II.—TABLE OF PROXIMATE ANALYSES OF MISSOURI COALS.

Rank.	Name of Mine.	Water per cent.	Volatile matter per cent.	Fixed carbon per cent.	Ash per cent.	Sulphur per cent.	Volatile matter plus carbon.
1	No. 8 Western Coal Co.	2.35	35.73	53.72	8.20	4.10	89.45
2	No. 3 Weir Coal Co	3.62	34.40	53.98	8.00	4.02	88.38
3	Brush Creek Coal Co	10.30	40.04	45.35	4.31	2.35	85.39
4	No. 14 Central Coal Co. Upper Vein	2.02	40.80	46.39	10.79	6.57	87.19
5	Rush Coal Co	4.07	41.05	43.22	11.66	3.38	84.27
6	Keene	6.17	40.83	45.04	7.96	3.72	85.87
7	Thompson	8.95	34.75	51.28	5.03	1.11	86.03
8	Henry	9.62	38.50	45.63	6.25	2.78	84.13
9	Cooper Creek Coal Co	7.24	34.60	48.10	10.06	2.64	82.70
10	Kingston	10.63	38.58	44.03	6.76	2.54	82.61
11	Caldwell Coal Co	9.26	36.69	43.56	10.49	3.61	80.25
12	Bowen Bros.	6.65	40.27	40.68	12.40	4.67	80.95
13	Watkins	8.10	36.13	45.02	10.75	4.72	81.15
14	Excelsior	10.25	36.10	44.69	8.96	3.54	80.79
15	Vernon Coal Co	6.34	35.89	44.47	13.30	4.81	80.36
16	Marceline Coal Co	9.45	33.25	47.27	10.03	5.73	81.52
17	Murlin Coal Co	14.78	39.10	42.44	3.68	2.16	81.54
18	No. 15 Rich Hill Coal Co	5.88	35.20	44.72	14.20	4.83	79.92
19	Edmonds	9.55	35.23	46.42	8.80	3.15	81.65
20	No. 6 Farmers Consolidated	11.95	36.14	44.70	7.21	2.57	80.84
21	No. 66 Kansas & Texas Coal Co	12.00	39.10	41.83	7.07	3.44	80.93
22	Silver Creek Coal Co	8.34	37.68	41.34	12.64	5.28	79.02
23	Elliott Coal Co	11.15	36.32	42.77	9.76	3.55	79.09
24	Buckhorn Coal Co	8.58	38.20	42.04	11.18	4.90	80.24
25	No. 10 Morris Coal Co.	9.90	31.73	47.33	11.04	2.86	78.06
26	No. 70 Kansas & Texas Coal Co	10.20	36.26	43.16	10.38	4.47	79.42
27	Murlin Coal Co.	13.07	37.85	41.66	7.42	1.92	79.51
28	Salt Fork Coal Co.	11.88	35.76	43.64	8.72	3.76	79.40
29	Jones & Davis	11.05	36.87	41.65	10.43	6.56	78.52
30	Brush Creek Coal Co., Lower Vein	7.85	33.18	44.17	14.80	5.05	77.35
31	No. 1 Higbee	10.00	29.99	50.77	9.24	3.57	80.76
32	Labor Exchange	12.31	35.91	43.58	8.20	1.71	79.49
33	No. 1 J. C. McGrew	15.02	34.20	43.20	7.58	2.97	77.40
34	Emporia	17.48	36.01	42.40	4.11	2.38	78.41
35	No 61 Kansas & Texas Coal Co	12.12	37.43	41.30	9.15	3.74	78.73
36	Richmond & Camden Coal Co	9.83	37.93	42.99	9.25	3.21	80.92
37	No. 11 Richmond & Camden Coal Co	11.97	36.36	41.65	10.02	4.36	78.01
38	No. 8 Mendota Coal Co	17.29	37.19	41.43	4.09	2.66	78.62
	Mo. City Coal Co	12.45	34.48	42.44	10.63	2.95	76.92
39	No. 14 Richmond & Camden Coal Co	10.20	36.75	41.20	11.85	5.87	77.95
40	Corder Coal Co	9.90	35.08	43.05	11.97	4.78	78.13
41	Glen Oak, Lexington Coal Co	14.39	35.00	44.58	6.03	2.01	79.58
42	Valley Mine, Lexington Coal Co	13.75	35.30	42.40	8.55	2.22	77.70
43	Northwestern Coal Co	11.00	31.77	45.74	11.49	4.28	77.51
44	No. 2 Higbee.	10.84	28.28	49.30	11.58	5.68	77.58
45	Dover Coal Co	12.33	34.53	42.05	11.09	4.56	76.58
46	Rombauer	12.12	30.10	44.20	13.58	3.52	74.30
47	Carter	11.56	32.93	42.10	13.41	3.50	75.03
48	Graddy, Lexington Coal Co	12.33	31.55	42.64	13.48	3.94	74.19
49	Grundy Coal Co.	10.07	31.62	43.90	14.41	5.43	75.52
50	J. B. Seitz	10.13	32.23	41.74	15.90	7.56	73.97
51	No. 2 Mendota Coal Co	17.59	34.11	39.85	8.45	3.21	73.96
52	Mayview Coal Co	10.50	32.43	40.63	16.44	3.48	73.06
53	Blackbird	13.46	34.88	38.36	13.30	4.29	73.24
54	Lingo	10.16	29.78	41.26	18.80	7.33	71.04

It is not claimed that the calorific values, as obtained and tabulated on a basis of 60 per cent boiler efficiency, are the real measures of the heating values of the various coals, but merely indices thereof and aids to a comparative estimate only.

The only way to obtain these real values for different coals at any given steam plant is to burn equal quantities of them under the same boiler, all conditions being the same for all the tests. The coal that is most economical for one steam plant under its peculiar conditions is not necessarily the most economical for another, on account of the furnace, grate area, etc. In addition to testing the coals by burning them under a boiler and determining the number of pounds of water evaporated per pound of coal, a record of the proximate analyses should be kept, in order to establish a standard of quality in making future purchases. Such a record will show that coals, ranging between certain percentages in volatile matter, moisture, fixed carbon, ash, and sulphur, are the more economical.

Sulphur occurs in coals as sulphide of iron, commonly known as iron pyrites, and sulphate of lime, usually known as gypsum. The sulphur is an index of the clinker-forming property of a coal since it assists in the fusing of the ash.

The heating value of a coal, depending chiefly upon the per cent of fixed carbon, and less upon the per cent of volatile matter, is materially affected by the per cent of ash, moisture and sulphur in the form of gypsum. These percentages vary with individual mines and with different places in the same mine. The amount of ash in the commercial product depends in great measure upon the care taken at the mines in cleaning it before shipment. The evaporating capacity of a boiler having a given number of square feet of heating surface and grate area, depends primarily upon the number of heat units generated in the furnace. The greater the number of heat units a given coal produces per pound, the greater will be the number of pounds of water evaporated per pound of coal burned under this boiler.

If a coal contain a large per cent of moisture and hydrogen, not only will the number of heat units derived be reduced by evaporating this moisture present and formed, but also by heating this aqueous vapor to the temperature of the chimney, all of which heat escapes and in no way serves to furnish heat to the boiler.

If a coal is high in the percentage of ash, not only will its heat value be diminished, but the quantity of ash and clinker resting upon the grate bars will tend to reduce the draft area and hence will prevent perfect combustion. Moreover the gases which would otherwise burn and produce heat with a proper air supply are in danger of escaping unburned. A coal high in content of ash demands a stronger draft and a larger grate area than one with a lower content. A boiler designed with a furnace to burn a coal with a low percentage of ash will give very unsatisfactory results with a coal having a large percentage of ash, and vice versa. In other words, a boiler furnace should be designed as nearly as possible for a given quality of coal, from which it is evident that with a given grate area the quality of the coal determines in a great measure the capacity and economy of a boiler.

Table III is a summary of tests of various Illinois coals ranked according to the sum of the percentages of fixed carbon and volatile matter.

It seems to be shown in table II that the amount of the fixed carbon and volatile matter puts the various coals, with a few exceptions, in the same order as does the calorific value. Hence it was thought well to arrange the Illinois coals so as to compare them with coals from Missouri according to the amount of fixed carbon and the volatile matter, as the calorific values of Illinois coals were not available. A careful study of tables II and III will show that Missouri coals compare well with those from Illinois.

III.—TABLE OF PROXIMATE ANALYSES OF ILLINOIS COALS.

Rank.	Shipper.	County.	Name.	Town or District.	Moisture.	Volatile matter.	Fixed Carbon.	Ash.	Sulphur.	Volatile matter plus Carbon.
‡ 1	New Kentucky Coal Co ...		Big Muddy Lump		2.29	37.78	54.53	5.40	.94	92.31
† 2		Jackson ...		Mt. Carbon ...	6.1	24.7	66.5	2.7	.....	91.2
† 3		Vermillion .		Danville ..	4.8	43.7	45.4	5.2	.....	89 1
‡ 4	Glenburn Coal Co		Mine Run		1.66	46 33	41.32	10.69	3.20	87.65
‡ 5	New Kentucky Coal Co....		Murphysboro		3.71	36.25	50.30	9.74	1.50	86.55
† 6		Jackson ...		Carbondale ...	6 4	26.4	59.8	7.4	....	86.2
‡ 7	T. C. Loucks		Lump		3.54	43.44	42.71	10.31	3.89	86.15
† 8		St. Clair...		Heintz Bluff ...	9.0	37.8	48.2	5 0	3.3	86.0
‡ 9	Du Quoin Union Coal Co...		Du Quoin Lump.		3.85	37.39	48.54	10.22	1.86	85.93
‡ 10	New Kentucky Coal Co....		Big Muddy Nut ..		5.13	36.36	49.44	9.07	1.17	85.80
† 11		Vermillion .		Danville.	11.0	32 6	53.0	3.6	. .	85.6
‡ 12	T. C. Loucks		Pea		3.32	41.68	43.90	11.10	3.87	85.58
† 13		Peoria		Peoria..... ...	3.2	36.1	49.2	11.4	.....	85.3
† 14		Jackson ..		Big Muddy	6.4	30.6	54.9	8.3	1.5	85 2
‡ 15	Williamsville Coal Co		Nut		2.45	43.50	41.69	12.36	4.20	85.19
† 16		Fulton		Cuba	4.2	36.4	48.6	10.8	.. .	85.0
† 17	{	{ Jackson . .		Big Muddy	7.7	31.9	53.0	7.4	.. ...	84.9
†	{	{ Marion . . .		Odin	6.1	34 0	50.9	9.1	..	84 9
‡ 18	Williamsville Coal Co		Pea		2.65	42 25	42.62	12.48	3.70	84.87
† 19		La Salle ...		Peru	6.6	37.2	47.2	9.0	.....	84.4
‡ 20	Virden Coal Co		Nut		5.15	40.82	43.54	10.49	3.78	84.36
† 21		La Salle....		Streator	7.2	38.9	45.3	8.6	...	84.2
† 22	{	{ La Salle...		Streator	12.0	35.3	48.8	3.9	2.4	84.1
†	{	{ Perry		Du Quoin	8.9	23.5	60.6	7.0	.....	84.1
† 23		Sangamon..		Riverton	6.4	35.4	48.4	9 8	.....	83.8
† 24	{	{ Fulton		Canton	3.5	37.0	46.7	12.8	. ....	83.7
†	{	{ Macon ...		Niantic.....	7.9	36.3	47.4	8.5	.....	83.7
‡ 25	Gardner Wilmington		Mine Run		7.90	45.95	37.60	8.55	2.93	83 55
† 26		Vermillion' .		Danville.	5.6	37.1	46.4	10.9	.....	83.5
† 27	{	{ La Salle...		La Salle.....	8.2	39.4	44.0	8.4	.	83.4
†	{	{ Macoupin .		Staunton	6.3	57.1	26.3	10.3	.. ..	83.4
‡ 28	T. C. Loucks.....		Nut		2.80	42.40	40.46	14.34	3.86	82.86
† 29		Macoupin ..		Mt. Oiive	10.4	36.7	46.1	6.8	3.5	82.8
† 30		Sangamon..		Loose's	10.7	37.6	45.1	6.6	2.4	82.7
† 31		Clinton ...		Trenton	13.3	30.4	52.0	4.3	0.9	82.4
† 32	{	{ Christian .		Pana	7.2	36.4	46 9	9.5	... .	82.3
†	{	{ Logan		Mt. Pulaski ...	7.7	35.8	46.5	10.0	....	82.3
‡ 33	Black Diamond Coal Co...		Duff.		1.29	40.80	41.32	16.59	5.10	82.12
† 34		Sangamou..		Barclay	7 4	35 7	46.2	10.7	.....	81.9
† 35	{	Grundy		Morris.....	7 1	32.1	49.7	11.1	....	81.8
‡	{ Crerar Clinch & Co.....		Pana Pea.....		4.70	41.20	40.60	13.50	3.68	81.8
‡ 36	Steck Coal and Coke Co....		Lump		4.30	42.53	39.25	13.92	2.59	81.78
† 37		McClean ...		Bloomington . .	4.1	36.4	45.2	14.7	.....	81.6
‡ 38	T. C. Loucks.....		Duff....		1.24	39.04	42.21	17.51	4.31	81.25
† 39		Peoria . ..		Pottstown . . .	4.6	35.5	45.5	14.4	....	81.0
‡ 40	Riverton Coal Co		Pea		3.94	41.10	39.88	15.08	3.96	80.98
† 41		Fulton		St. David . .	2.0	34.6	46.2	17.2	....	80.8
† 42	{	{ Macoupin .		Girard	9.7	34.4	45.8	10 1	3.5	80.2
†	{	{ Perry		Du Quoin.....	11.3	30.3	49.9	8.5	0 9	80.2
‡ 43	Wilmington Coal Co.....		Washed		5.14	39.30	40.88	14.68	3.30	80.18
‡ 44	Crerar Clinch & Co		Illinois Central ..		1.81	36.04	44.12	18.03	3.99	80.16
† 45		Fulton		Farmington...	3 4	33.9	45.9	16.8	.....	79.8
† 46	{	{ Logan ..		Lincoln	8.4	35.0	44 5	12.1	.....	79.5
†	{	{ Marion ...		Centralia	8.3	34.0	45.5	8.0	....	79.5
† 47		St. Clair...		St. Bernard....	14.4	30.9	48.4	6 4	1.4	79.3
‡ 48	Crerar Clinch & Co		Du Quoin Pea...		3.15	38.94	39.99	17.92	3.18	78.93
‡ 49	Chicago & K. C. Coal		Duff.		1.15	37.89	41.02	19.94	3.36	78.91
† 50		Fulton		Dunfermline ...	2.5	32.9	45 6	19.1	.... .	78.5
‡ 51	Colfax Coal & Mining Co...		No. 2, Nut.....		2.61	41.36	36.96	19.07	4.19	78.32
† 52		Peoria		Edwards	1.9	34.5	43.6	20.0	.....	78.1
† 53		Bureau.....		Ladd	12.0	32.3	42.5	13.8	.....	77.6

‡ These analyses were made by the Illinois Steel Company at their Chicago plant and were doubtless taken from cars in the coal company's yards, hence the low per centages of moisture.

† These analyses were made by various persons and are published in Kent's Steam Boiler Economy and were doubtless taken from the mines.

III.—TABLE OF PROXIMATE ANALYSES OF ILLINOIS COALS.—(Continued.)

Rank.	Shipper.	County.	Name.	Town or District.	Moisture.	Volatile matter.	Fixed Carbon.	Ash.	Sulphur.	Volatile matter plus Carbon.
† 54		St. Clair		Oakland	8.3	34.4	43.1	14.2	4.4	77.5
† 55		Macoupin		Mt. Olive	8.1	33.1	44.1	14.7	.....	77.2
‡ 56	Girard Coal Co		Pea		.95	36 85	40.24	21.96	3.56	77.09
† 57		St. Clair		Vulcan	10.3	27.9	49.0	12.8	0.7	76.9
† 58		Fulton		Clair	3.2	32.9	43.1	20.8	.....	76.0
† 59		Macoupin		Gillespie	12.6	30.6	45.3	11.5	1.5	75.9
‡ 60	Crerar Clinch Co		Pana Duff		4.88	35 59	40.11	19.42	3.58	75.7
† 61		Fulton		Bryant	2.4	32.9	42.6	22.0	.....	75.5
† 62		La Salle		Streator	9.9	33.2	42.2	14 6	.....	75.4
† 63		Bureau		Ladd	12.0	32.3	42.5	13.2	.....	74.8
† 64		Bureau		Seatonville	10.0	33.8	40.9	15.3	...	74.7
† 65		Will	Wilmington Lump		15.5	32.8	39.9	11 8	.....	72.7
‡ 66	Crerar Clinch & Co		Centralia Duff		1.50	36.10	36.00	26.40	4.04	72.10
†		Sangamon		Barclay	10.8	27.3	44 8	17.1	.....	72.1
† 67		Madison		Collinsville	9.3	29.9	40.8	16.1	3 9	70.7
† 68		Bureau		Colchester	11.6	25 0	44.8	18.6	.....	69.8
‡ 69	Wenona Coal Co		Duff		1 72	33 58	34.74	29.96	4.37	68.32
† 70		Perry		St. John	13.6	24.5	43.5	15.4	1.8	68.0
† 71		Peoria		Elmwood	1.4	27.7	35.4	35.5	.....	63 1

‡ These analyses were made by the Illinois Steel Company at their Chicago plant and were doubtless taken from cars in the coal company's yards, hence the low per centages of moisture.

† These analyses were made by various persons and are published in Kent's Steam Boiler Economy and were doubtless taken from the mines.

The Determined Distribution of Coals in Missouri.

By C. F. Marbut, Professor of Geology.

The accompanying map shows the distribution, so far as known, of the more important coal beds of Missouri. The continuous line along the border of the shaded area indicates that the limit of the coal bed in this direction is determined. Where there is no sharp border to the shaded area it indicates that the coal bed may extend further.

The Bevier coal bed is the thickest and has the widest distribution. Over the area outlined on the map it has an average thickness of nearly four feet. The thickness within the area of any one mine or mining region is essentially uniform, and it is rarely interrupted by faults. "Horses" or "clay rolls" occur occasionally, but not abundantly enough to cause serious interference with mining.

The roof is a sandy shale, sometimes occuring as a sandstone. It is solid enough to furnish a safe roof when properly supported, and in some places it is secure enough for long-wall mining.

The coal bed rests on a layer of underclay with an average thickness of about a foot. This is usually taken up in the roadways, since it is easier to do this than to "brush" down an equal thickness of the shale. The clay rests on a bed of limestone about five feet thick, which gives a solid foundation for the roadway. All through the southern end of this coal field the coal bed consists of

two layers of coal, with a one-inch parting of pyritiferous shale. North of Adair county this shale seems to thicken and finally to become thick enough to separate the bed into two independent beds with several feet of shale between them.[1]

The Lexington coal bed is shown on the map to cover a large area along the Missouri river east of Kansas City. It may be said in passing that the unbroken extent of this coal bed over the whole of the area shaded is not proved beyond question. There are mines, however, scattered over this area which operate coal beds of about the same thickness and character as the Lexington bed, and presumably they are the same. It is known to extend southward into Johnson county, but is too thin to be mined profitably under existing conditions. The thickness of the bed within the shaded area varies from sixteen to twenty-six inches. It is overlaid by two feet of black fissile shale, and that in turn by six feet of limestone, making an excellent roof. It is underlaid by a clay bed, about one foot thick, and this in turn by a bed of lime stone about four feet thick.

The character of the roof and under clay and the thickness of the bed make this an ideal coal for long-wall mining.[2]

The Mendota coal bed, when of minable thickness, covers a larger area in Iowa than in Missouri. It is only its southern end that extends into Missouri. Its thickness varies from two and a half to a little more than three feet. It is overlaid by black fissile shale or "slate" about two feet in thickness, and this in turn by about four feet of limestone, thus furnishing a good roof, and by "brushing" down the shale, giving room for good roadways without the necessity of digging much beneath the level of the coal bed. There is no limestone bottom rock to this coal bed.

A coal bed which is thought to be the same as the Mendota coal extends over the greater part of the area of the Bevier coal. It is, however, too thin to be mined on a large scale under existing conditions. In Randolph and Macon counties it is about eighteen inches thick. It is mined for blacksmithing purposes at a few places and is said to be of extra quality.

The Tebo coal bed is confined chiefly to Henry county. Its geological relation to the Lexington coal bed is not known. Its average thickness is about two feet and a half. It is overlaid, like the Lexington coal, by two to three feet of shale with a two foot limestone bed overlying the shale. It is underlaid by a few inches of clay and then sandy shales and sandstones extend down to the base of the coal measure series.

The Tebo coal is hard and compact, but it contains rather abundant lenticular masses of pyritiferous shale which must be picked out before the coal is in good condition for the market.

The Jordan coal bed underlies a small area in the vicinity of Deepwater and Brownington, in Henry county. The bed is three and a half to four feet thick, and is underlaid and overlaid by shales. A large part of the area, where this coal bed is thickest, has been worked out.[3]

The Rich Hill coal bed lies in the southwestern part of the state. It is not fully demonstrated that the same coal bed extends over the whole of the area shaded for the Rich Hill coal on the map. It is, however, known that coal of minable thickness underlies this area, and for that reason it was all shaded alike. The thickness of the bed varies from thirty to forty-eight inches, and locally is a little thicker. It is overlaid by shale and underlaid by shale in some places and by clay in others.[4]

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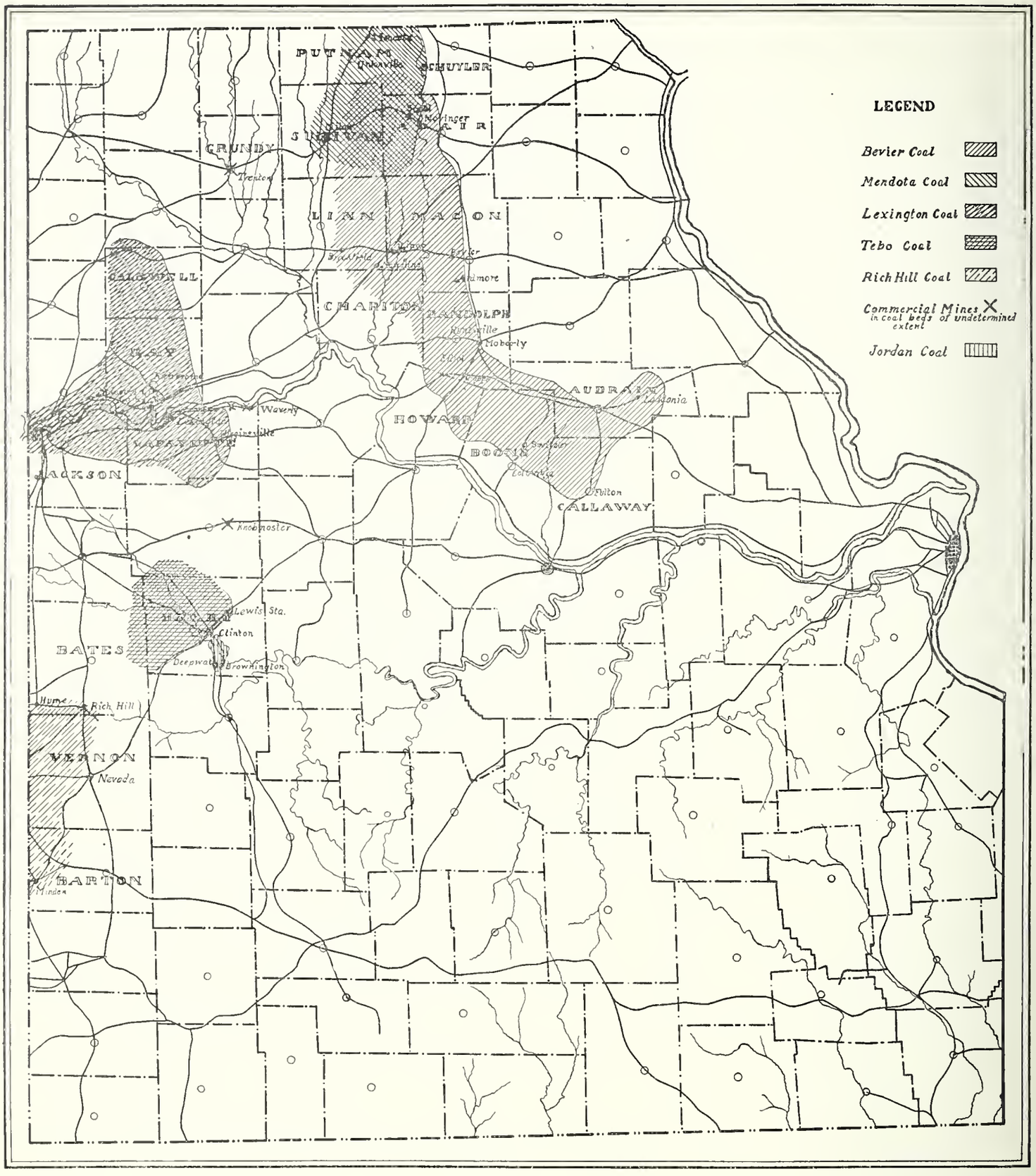
(1) For the detailed geology of this coal bed in Randolph and Macon counties, see the Geology of the Huntsville Quadrangle in Vol. XII of the Reports of the Missouri Geological Survey and "The Bevier Sheet" in Vol. IX of the same reports.

(2) For the detailed geology and distribution of this coal bed in Ray and Lafayette counties, see the Geology of the Lexington Quadrangle, the Geology of the Richmond Quadrangle in Vol. XII., Reports of the Mo. Geol. Sur., and the Higginsville Sheet in Vol. IX.

(3) For detailed description of the Geology of Henry county see the Reports on the Geology of the Clinton and Calhoun sheets in the Reports of the Missouri Geological Survey, Vol. XII.

(4) For more detailed descriptions of the coal bed and the mines in this part of the state, consult the Preliminary Report on Coal, Vol. I,. Mo. Geol. Survey, 1891

MAP OF MISSOURI, SHOWING THE VARIOUS COAL BEDS.



In conclusion, thanks are due to the various mine operators for their kind co-operation, the Wabash; Missouri, Kansas and Texas; Burlington; Missouri Pacific; and Omaha, Kansas City and Eastern railroads for courtesies extended.